Missouri Department of Natural Resources
"Integrity and excellence in all we do"

Tree Species for Missouri's Lands

Land Reclamation Program fact sheet 7/2003

Tree planting on mine lands is an effective practice to improve wildlife habitat while increasing the economic value of land. Tree planting also can improve a rural area's ecological diversity by returning native hardwood species that may have declined in numbers due to development pressures or agricultural use. Mine lands can be very productive forest lands for valuable hardwoods such as black walnut and oak, making such lands especially important in western Missouri where forest resources are limited in extent and in value.

Species selection is an important consideration prior to planting. Native tree and shrub species tend to be better adapted to Missouri environmental conditions than exotics. Many excellent native species that greatly improve wildlife habitat and forest resource are now commonly available to tree planters. Soil conditions play a major role in successful tree establishment and in achieving good growth rates. Land managers must be aware of these conditions before trying to plant. Extremely acid or barren mine sites require special planning to ensure success. For more information on tree planting methods, see *Tree Planting on Missouri Mine Lands* (pub 2085).

Mine Soils, Soil Development and Natural Succession

Freshly graded mine spoils must be conditioned by pioneer plant species, which add organic matter and nutrients to the young soil. Soil organic matter feeds beneficial soil organisms such as earthworms which, recycle nutrients which can be used by other plants. Soil organism populations are often low or nonexistent on mine sites. Most soil organisms are too small to move overland and depend upon air, water or larger animals to transport them to the mine sites. They must already be present nearby or these modes of transport can take a long time.

Mine soils may only support very simple plants like mosses and lichens until soil organisms arrive. Commonly found on tree bark and rocks, lichens are combinations of algae and fungi that live together in a "symbiotic" relationship. Lichens and mosses colonize the mine site's surface. They form a water- and nutrient-rich crust that enables seeds of higher plants, such as broomsedge, to germinate and grow. Broomsedge can tolerate very poor, infertile and acid soils. Roots penetrate beyond the surface crust and, in combination with soil organisms, initiate soil formation below the surface. Soil fertility is improved as organic matter is accumulated and microbial populations increase, which allows more nutrients to be stored and released to plants in the soil. Organic matter and soil organisms improve soil structure. They produce sticky substances that bind individual soil particles into larger combinations. This enables water, air and plant roots to move more easily throughout the soil, improving soil productivity. Within a year or two, trees are ready to colonize the mine soil and bring even more changes to the soil system. This process of change and development of the mine soil and plant community is called **natural succession**. (Note: **Mine spoils** are the upturned earthen materials moved by coal miners to

PUB002084

reach the coal in surface mining. Most mine spoils in Missouri are either shale or soft sandstone rock that weathers or breaks down quickly to soil-sized particles. **Mine soils** are the soils that develop from the mine spoil. The U.S. Department of Agriculture defines **soil** as *"earthen materials that can support rooted plants*." Soil also must include soil organisms that make it productive. Until mine spoils can support rooted plants, they are not truly "soil." **Dirt** is a term used by some, but only **soil** supports plants.)

Natural succession of mine lands often mimics that of old fields. Trees and shrubs colonize old fields and mine lands in predictable patterns based on the availability of woody plant seeds. Simply, if seed-producing trees like walnut, oak and hickory are not present, those species cannot colonize mine lands. Valuable hardwood trees must be planted in many instances. Plants that colonize mine lands first are called "**pioneer**" species. Broomsedge, blackberries, wild plum, redcedar and cottonwoods are examples of pioneer or early successional stage plants that can withstand harsh soils that are often acidic, nutrient-poor and droughty. Late successional plant species such as oak, walnut and pecan colonize mine lands after the pioneer plants have ameliorated the mine soil conditions.

Land managers can speed this process by planting legumes such as clovers, alfalfa and lespedeza that take nitrogen directly from the air. Legume roots are colonized by a type of bacteria that can take nitrogen gas from the soil air and convert it into nitrogen compounds that plants can use. This is another kind of symbiotic relationship, where the bacteria provide nitrogen to the clover, which, in return, provides plant sugars, or carbohydrates, to the bacteria. Both organisms benefit from this relationship. Nitrogen and phosphorus typically are in short supply in mine soils. Legumes produce nitrogen-rich organic matter that enriches the soil and feeds soil organisms. These organisms in turn provide nitrogen and other nutrients to trees and grasses that cannot fix atmospheric nitrogen. Virtually all nitrogen and phosphorus used by plants are released by soil organisms consuming and converting organic matter.

In years past, farmers would grow legumes and turn them into the soil to increase the level of nitrogen-rich organic matter and provide nitrogen to crops before chemical fertilizers were available. This soil improvement process is called **green manuring.** Land managers can greatly improve mine soils by growing green manure crops.

Compaction and Competing Vegetation

An ideal soil would be ½ solid, 1/4 air and 1/4 water for plant growth. Soils that are compacted by vehicles, earth-moving equipment and livestock lose much of the ability to hold water and air as the open spaces or **soil voids** are closed and the soil particles are pressed together. This greatly limits plant growth and accentuates drought stress. Roots have difficulty in growing in compacted soils which further limits plant growth. Low organic matter levels, low plant root concentrations and weakly-developed soil structure make mine soils more susceptible to compaction than native soils. These conditions magnify compaction effects on mine soils. Discing, ripping or roto-tilling can break up compaction. Water infiltration followed by freezing and thawing cycles in winter can naturally break up compaction over time. Tree roots can penetrate into existing soil cracks and mitigate compaction.

Dense, competing herbaceous vegetation can play a major role in limiting seedling survival. This is especially true on mine soils. Young tree seedlings must quickly develop a root system that can compete with grasses and forbs for water and nutrients. Often, a newly planted tree has lost all of its feeder roots and most of its lateral roots when lifted from the nursery bed. It takes

several weeks to regenerate a new root system. If this cannot be done by early summer, then the seedling may not survive into the summer due to herbaceous competition for water and nutrients.
Compaction and herbaceous competition are the two important causes of planting failure on graded mine lands. More trees have gone to their deaths because treeplanters have not mitigated compaction or reduced herbaceous competition before planting. The trees that do survive grow very slowly and are susceptible to diseases and insect pests. **Do not waste** money and resources planting trees in a fescue sod, growing in compacted mine soil.

Trees and Mycorrhizae

Trees form symbiotic relationships with various species of fungi. Fungi invade living tree roots and obtain carbohydrates produced by the tree in photosynthesis. Fungal tissue called **mycorrhizae** surrounds and penetrates the roots of most species of trees. The fungi send long strands of root-like tissue called **hyphae** throughout the soil. Hyphae act like roots taking water and nutrients from the soil and passing them to the tree. The mycorrhizal fungi act like a great extension of the tree's own root system in the soil. Mycorrhizae play such a significant role that many tree species do very poorly or cannot survive without them. Fungal hyphae are particularly more efficient than tree roots in obtaining phosphorus from the soil. The correct species of mycorrhizae may not be present in young mine soils. Fortunately, some species of fungi produce aboveground fruiting bodies called mushrooms, toadstools and puffballs that have their reproductive spores blown around to new locations by the wind. Other species have their fruiting bodies underground, called truffles, and spread their spores by animals or water. Usually, tree planters need not worry about mycorrhiza because most nursery trees are already infected. However, always check with the nursery to ensure that the seedlings have been inoculated with mycorrhizae.

Extremely Acid Mine Soils

Some Missouri mine spoils produce extreme amounts of acidity that slow the process of soil creation and colonization by trees. In such harsh soils, it takes much more time to create the conditions that allow plants to thrive. Some mine sites in Missouri are more than fifty years old and still cannot support many plants. These largely barren sites quickly erode, causing significant environmental problems. The surface crust of lichens and mosses play a great role in slowly changing the soil conditions that enable higher plants colonize the area.

Certain spots in the mine area are less acid, allowing plants to move in more quickly. Plants first tend to colonize areas that are protected from excessive erosion and collect water or blowing organic matter like leaves. These areas include protected valleys between spoil ridges and cooler north-facing slopes. Erosion easily removes the beneficial soil crust exposing fresh mine spoil that must undergo the entire soil formation process again. Blackberries, wild plum and sumac spread from less acidic adjacent soils into the acidic "hot spots" by underground stems called rhizomes. Rhizomatous plants shade the hot spots, catch blowing organic matter and enable other plants and soil organisms to grow and develop, improving the soil and hastening soil formation and natural succession. These "islands of vegetation" are crucial to the natural revegetation of acidic mine soils.

Missouri is fortunate that most of its mine soils are not so acidic as other states, particularly those in the east. With proper management, most mine sites can be successfully revegetated, though time or a lot of money may be required to do the job on the worst sites.

Species Selection

Land managers should select the proper species to be planted on the mine site. Native species are adapted to Missouri's environmental conditions and tend to do better than exotics species on mine lands in the long-term. Due to increased demand, more native tree and shrub species are available to tree planters than in the past. Many of these do very well on Missouri's mine lands. Exotic or nonnative species including conifers often do not survive as well, or do not live as long as many native species. Other exotics grow and reproduce too well and readily spread to adjacent fields and pastures. Autumn olive, Japanese honeysuckle and sericea lespedeza are exotic species that have few natural controls on their reproduction and are spreading out of control in Missouri. Unfortunately, many of the exotic species planted on mine lands in the past have now become pests that are expensive to control and are damaging to existing plant communities. Native species tend to have predators or pathogens that prevent such uncontrolled expansion. Some native species may be troubling to farmers but are very important for wildlife.

Often landowners want to establish pines on their mine lands. Unfortunately, many mine lands and Missouri's climate is not conducive to the establishment and the long-term maintenance of pines. Most pines are short-lived in Missouri under the best conditions. For example Scots pine, rarely lives past 25 years. Virtually all pines on Missouri mine sites will decline with time and will be replaced by hardwoods. Land managers must be prepared to follow pines with hardwood plantings if nut-producing oak, hickory or walnut trees are not present to seed under the declining pines. Native redcedar is a good coniferous replacement for pines on Missouri mine lands. Shortleaf pine may be grown successfully as well.

Tree Species for Mine Lands

Many reclamation practioners and tree planters have different viewpoints on the selection of species and their success on mine lands. Each person should adapt to local conditions and find out what methods and species work best on a specific location. There is no universal recipe for success except adapting to site specific conditions.

Bur Oak (*Quercus macrocarpa*) is extremely successful on many mine sites due to its drought tolerance. Bur oak develops a deep, extensive root system that can penetrate cracks in compacted mine soils. This characteristic aids in the breakup of the compacted layers. It is tolerant of a wide variety of soil conditions, including dry sites, and saturated soils during the winter.

Swamp White Oak (*Quercus bicolor*) is an excellent replacement for buroak if the soil is excessively wet. Both species produce large, nutritious acorns relished by wildlife. Bur Oak can survive herbaceous competition better than most trees due to its extensive root system and readily reproduces itself from seed planted by squirrels.

White Oak (*Quercus alba*) is often difficult to establish on mine sites. It is intolerant of competing vegetation and of compaction. However, on loose, well-drained abandoned mine soils (pH 5.0 or above), white oak can be very successful and achieve good growth. Some white oak stands have growth rates on good mine soils as high as those on the best native soils. In Missouri's prairie areas, white oak follows bur oak after it initially colonizes and shades out grass stands.

Northern Red Oak (*Quercus rubra*) requires moist, well-drained mine soils with minimal compaction and competing vegetation. Planting success and subsequent growth depend upon good drainage, good available moisture and moderate fertility. **Shumard Oak** (*Quercus*

shumardii) is very similar in appearance to northern red oak, but is more tolerant of both drier and wetter soil conditions. Shumard oak may be a better all-around selection for Missouri mine lands. Lumber from these oaks is sold as “red oak” and has become extremely valuable due to increased demand.

Pin Oak (*Quercus palustris*), a common natural invader of mine spoils is adapted to acidic, compacted soils with poor drainage. Its abundant, small acorns are very important for wildlife. Pin oak is extremely successful on reclaimed mine sites and is easily established. It is difficult to walk through a stand of pin oaks due to their descending branches and the inability to self-prune those branches. Loggers will not cut pin oak because the logs are ruined by these branches.

Other Oaks- shingle, post, black and chinkapin oaks can be locally common invaders of abandoned mine lands. Often, these native oaks do very well on mine soils but typically are unavailable from nurseries. **English Oak** (*Quercus robur*) is a nonnative oak that can do well on clayey, compacted soils. **Sawtooth Oak** (*Quercus altissima*) from Asia has been planted for nut production in surrounding states. However, with good native species of oak commercially available, introduced oaks should not necessarily be planted on mine lands.

Pecan (*Carya illinoensis*) is often difficult to establish on mine lands. Pecan successfully invades abandoned mine sites in Bates, Vernon and Henry counties. Container-grown pecan seedlings can greatly improve establishment success. Pecan grows very well on deep, uncompacted mine soils. Land managers can expect periodic nut production but will have to fight squirrels, blue jays, raccoons and coyotes for the pecans.

Black Walnut (*Juglans nigra*) is often difficult to establish on the best soils, much less mine soils. Once established on moist, well-drained, neutral mine soils, black walnut can make excellent growth. Container-grown seedlings can greatly improve establishment success. Nut production is good on well-drained, rich mine soils, but like pecans, most will be consumed by wildlife. Mine soil compaction greatly limits walnut establishment and slows growth.

Green Ash (*Fraxinus pennsylvanica*) is easy to establish on reclaimed mine lands. Growth is limited on acid, compacted or wet soils. **White Ash** (*Fraxinus americana*) has similar success rates as green ash on mine lands.

River Birch (*Betula nigra*) tolerates extremely acid spoils, lowlands and compacted, poorly drained mine soils. Seedlings readily volunteer on mine sites but planted, bare-root seedlings may be difficult to establish.

Black Cherry (*Prunus serotina*) volunteers readily on most abandoned mine sites. It prefers moist, well-drained mine soils that are slightly acidic. Successful establishment is difficult on acid mine soils, and growth is slow. Since most trees on mine lands will have multiple stems and grow crooked, the quality of such cherry lumber is often low.

Eastern Cottonwood (*Populus deltoides*) is the most common volunteer tree on most abandoned mine lands throughout Missouri. Due to its wind-blown seed, it is one of the first trees to become established on mine land. Although a bottomland species, cottonwood does not do well in poorly drained soils that are saturated during the growing season. Cottonwood casts a light shade, so oaks can be easily planted on mine lands and achieve good growth under a stand of cottonwood.

Hackberry (*Celtis occidentalis*) is locally common as a volunteer on abandoned mine lands. Birds eat the berries and drop the undamaged seed from their perches. Planting success is limited to well-drained, slightly acidic mine soils.

Silver maple (*Acer saccharinum*) is relatively easily established but makes poor growth on poorly-drained, droughty or moderately acidic mine soils. Wildlife browse is often excessive.

American sycamore (*Platanus occidentalis*) can be locally common on abandoned mine sites. Establishment success is moderate on reclaimed mine sites. It is somewhat tolerant of compacted mine soils. Sycamores growing near ponds or streams can become massive and are important den trees for wildlife.

Persimmon (*Diopryros virginiana*) is locally common on abandoned mine lands. Persimmon tolerates acidic, compacted mine soils and spreads into thick herbaceous cover by underground stems called rhizomes. Establishment success is moderate, but persimmon is an excellent wildlife species that is worth the effort to establish on reclaimed mine lands.

Other Hardwood Trees:

Sweetgum (*Liquidamber styraciflua*) and **tulip-poplar** (*Liriodendron tulipifera*) have been widely planted on better drained, more productive abandoned mine soils with good success. These trees are native to southeastern Missouri and tend to do poorly on dry, exposed mine sites. **Red mulberry** (*Morus rubra*) and **red elm** (*Ulmus rubra*) are locally common invaders of abandoned mine lands. Red mulberry can be readily established on better mine soils, greatly improving wildlife habitat.

Black locust (*Robinia pseudoacacia*) and European **black alder** (*Alnus glutinosa*) often were planted by coal companies throughout the Midwest. Both species add nitrogen to mine soils. Both species can be overly aggressive, shading out more desirable hardwoods. Black locust sprouts readily from roots. Extensive bulldozing and applications of herbicides may be necessary to control it. Black locust and black alder should be planted only on the most acidic mine sites.

Conifers

Conifers such as pines, spruces and firs typically perform very poorly on mine sites in Missouri. Many of the pine species grow slowly and are short-lived. Spruce and fir species should not be planted on Missouri mine sites.

Eastern White Pine (*Pinus strobus*) has been widely planted on mine lands. White pine can live up to 60 to 75 years on moist, well-drained sites. Seedling plantations have been destroyed by high deer populations.

Austrian Pine (*Pinus nigra*) has been somewhat successful on mine lands, but subject to numerous disease and insect problems that limit long-term survival.

Scots Pine (*Pinus sylvestris*) has a relatively short life span, providing limited wildlife habitat.

Pitch Pine (*Pinus rigida*) is short-lived, but adapted to extremely acid, well-drained soils. It has seen local establishment success in Missouri.

Jack Pine (*Pinus banksiana*) is adapted to well-drained, acidic soils. It has been moderately successful in Missouri, but its scruffy appearance may discourage some planters.

Virginia Pine (*Pinus virginiana*) has been planted widely with excellent success throughout the Midwest. Virginia pine may be a better selection than pitch or jack pines for droughty, acidic soils.

Shortleaf Pine (*Pinus echinata*) has been successfully planted in Missouri on well-drained, moderately acidic soils. Missouri's only native pine, shortleaf is a better selection for many mine lands than any other pine species. Animal browse in winter limits establishment success.

Eastern Redcedar (*Juniperus virginiana*) is a common volunteer species on abandoned mine lands. Redcedar is successfully established on a wide variety of moderately acidic soils. It does not do well on compacted, poorly drained mine soils that remain wet during much of the growing season. Animal browse damage is much less common on redcedar than on the pines.

Baldcypress (*Taxodium distichum*) has been widely planted throughout the Midwest on mine lands. It tolerates a wide range of soil conditions, including well-drained sites. It is particularly successful on waterlogged, compacted mine soils.

Small Trees and Shrubs for Wildlife on Mine Lands

Small trees and shrubs can greatly improve wildlife habitat on mine lands. Many species are acid-tolerant and spread onto acidic "hot spots" by rhizomes. Blackberries, rough-leaved dogwood, sumacs and white plum are particularly successful at this. Rhizomatous plants catch organic matter, provide shade and limit erosion, which in turn, allows windblown seed to germinate, promoting later successional species on the mine site.

Species

American Plum (*Prunus americana*) is locally common on abandoned mine lands. Wild plums tolerate acidic soils and spread into harsher sites by rhizomes. Plums are easily established and create excellent wildlife food and habitat.

Rough-leaved Dogwood (*Cornus drummundii*) is locally abundant on abandoned mine lands throughout Missouri. It is tolerant of acidic soils and spreads into harsh sites by rhizomes. **Gray dogwood** (*Cornus racemosa*) is similar to rough-leaved. Dogwoods are excellent wildlife species.

Hazelnut (*Corylus americana*) is locally common on abandoned mine lands in northern Missouri. It tolerates moderately acidic mine soils and spreads by rhizomes. Hazelnut is an excellent wildlife species but should not be planted on extremely acidic mine soils.

Willows (*Salix spp.*) are effective on mine lands in swales, streambanks, pondbanks and in wetlands. Willows are somewhat tolerant of acidic soils. They are important wildlife plants and play a major role in erosion control and streambank stabilization. Willows can easily be established by planting green sprigs in mud. Tree planters should place at least 12 inches of the twig in the mud while sprigging.

Blackberry (*Rubus* spp.) is locally abundant on mine lands. Blackberries are tolerant of extremely acid soil conditions. They spread into harsh sites by rhizomes. Blackberries are excel-

lent wildlife species and are easily established on mine sites. They tolerate compacted soils. Blackberries are under-utilized as a reclamation plant. Blackberries can be easily transplanted and established on mine lands.

Sumacs (*Rhus spp*.) are locally abundant species on Missouri mine lands. **Smooth sumac** (*Rhus glabra*) and **winged sumac** (*Rhus copallina*) are tolerant of acidic, compacted mine soils and spread by rhizomes into harsh mine sites. **Fragrant sumac** (*Rhus aromatica*) is similar but smaller in stature. **Poison ivy** (*Toxicodendron radicans*) is a close relative of the sumacs that is abundant throughout Missouri mine lands. While not intentionally planted by anyone, poison ivy is an important component of native plant communities, providing food to wildlife and promoting tree growth and development on mine lands.

Indigobush (*Amorpha fruticosa*) is locally common on mine lands in western Missouri along streambanks and shorelines. It often forms thickets along shorelines, spreading by rhizomes, and is an excellent plant for streambank and storm drainage swales. Limited commercial availability often prohibits the use of indigobush, but volunteer stands can provide plant materials for transplanting. Using a sharp spade or shovel, small clumps of indigobush can be removed. Immediately replant the clump, with soil still attached, in a hole so that the top of the plant is slightly below ground level. Planters must be environmentally responsible while transplanting so as not to cause large-scale disturbance. It is unethical and unlawful to remove these plants from public land or recognized natural areas. Transplanting of indigobush has been relatively successful, although the plant should be dormant for the procedure. Indigobush can spread rapidly along shorelines once established.

Ninebark (*Physocarpus opulifolius*) has had limited planting use on mine lands, but has been effective on a wide range of native soils for streambank stabilization. Field trials on mine lands could indicate similar success on mine lands.

Buckbrush (*Symphoricarpos orbiculatus*) has seen limited planting use on mine lands. It spreads rapidly by runners and rhizomes, creating cover and starvation food for wildlife. Buckbrush is common on a wide variety of soil conditions in unmined areas. It is easily transplanted, and its shallow root system should adapt well to compacted mine soils. Field trials could indicate success on acidic mine lands.

Buttonbush (*Cephalanthus occidentalis*) has been successfully established on mine lands on shorelines, streambanks and wetlands. It is locally common in wet areas throughout Missouri.

Other Shrubs

Shrub lespedeza (*lespedeza bicolor*) and **bristly locust** (*Robinia hispida*) are legumes that are not native to Missouri. Like **autumn olive** (*Elaeagnus umbellata*) and **multi-flora rose** *(Rosa multiflora*), introduced trees and shrubs should be carefully and thoughtfully selected before planting to prevent establishment of potentially noxious plants. Bristly locust has been very successful on extremely acid mine lands. Most planters indicate that bristly locust is not evasive and cannot spread into a well-established sod. The risk of escape is not known in Missouri.

Bush honeysuckle (*Lonicera maackii*) and **Japanese**, or creeping, honeysuckle (*Lonicera japonica*) are extremely aggressive, evasive shrubs and vines that **should not be planted**. These species will completely eradicate existing vegetation, creating an ecological desert. Japanese honeysuckle is a local problem on Missouri mine lands. It will strangle or climb over

planted tree seedlings, killing them in a few years. Birds readily spread honeysuckle by eating the berries, then passing the seeds undamaged while perched on trees or fence rows. Eradication is virtually impossible without complete destruction of all plants by herbicides and grubbing out the root systems. The landowner who plants these honeysuckles will pay dearly in the years to come.

Herbaceous Ground Covers

Grasses and forbs play a major role in mine land stabilization and erosion control. However, overly aggressive ground covers limit tree-planting survival. Newly planted tree seedlings cannot compete with ground covers for water in the summer. Small seedlings can be shaded out by tall ground covers. Conifers are particularly shade intolerant.

As mentioned in Technical Assistance Bulletin 6, ***Tree Planting on Missouri Coal Mine Lands***, competing vegetation can be controlled by mechanical, chemical or a combination of means. Herbicide use is controlled by law and always follow the manufacturer's recommendations. Never remove ground covers in such a manner as to cause erosion.

Certain grasses and forbs used on mine lands provide excellent erosion control while allowing tree seedlings to thrive. However, even these species can be too aggressive if they are seeded at excessive rates. These species are:

Grasses*

Red Fescue (*Festuca rubra*)
Foxtail Millet (*Setaria italica*)
Redtop (*Agrostis gigantea*)
Perennial Ryegrass (*Lolium perenne*)
Timothy (*Phleum pratense*)
Japanese Millet (*Echinochloa crusgalli*)

Legumes

Alsike Clover (*Trifolium hybridum*)
Ladino Clover (*Trifolium repeus*)
Alfalfa (*Medicago sativa*) **
Common Lespedeza (*Lespedeza striata*)
Black Medic (*Medicago lupulina*)

* Warm-season, native grass stands are often open enough to allow drought-tolerant oaks and hickories to invade during cool, wet springs followed by a moderate summer. Do not apply excessive seed rates for ground covers. Excessive competition with the tree seedlings can result. Use a mixture of grasses and legumes whenever possible.

** Alfalfa can overtop small tree seedlings and out-compete them for water in the summer. Alfalfa should be a minor component in the ground cover.

Conclusion

Tree planting on mine lands is an effective means to improve wildlife habitat, promote landform stability, provide an economic return and create esthetically pleasing scenery. Mine soils are often extremely productive in terms of tree growth and nut production. Planning, the proper soil conditions and correct planting techniques are keys to successful establishment and long-term growth.

Shrubs play a major role in improving wildlife habitat and creating the proper soil conditions to establish trees on mine lands. Rhizome-forming shrubs colonize harsh, acidic "hot spots" from

the outside, collect organic matter, provide shade and improve soil-water characteristics to allow more demanding plants to survive. Trees and shrubs play a role in promoting natural succession and soil building on mine lands. Over time, mine lands are healed and can play an important role in the ecosystem.

For additional information on trees and tree planting, contact the Land Reclamation Program and your local Missouri Department of Conservation Forestry office.

Notes

Descriptive Terms: Soil pH*

Ultra acid	<3.5	Neutral	6.6 - 7.3
Extremely acid	3.5 - 4.4	Slightly Alkaline	7.4 - 7.8
Very Strongly Acid	4.5 - 5.1	Moderately Alkaline	7.8 - 8.4
Strongly Acid	5.1 - 5.5	Strongly Alkaline	8.5 - 9.0
Moderately Acid	5.5 - 6.0	Very Strongly Alkaline	>9.0
Slightly Acid	6.0 - 6.5		

*From U.S. Department of Agriculture, NRCS ***Soil Survey Manual***

Missouri Trees for Specific Mine Land Conditions

Moderately Acid - Neutral Soils

Oaks
Walnut
Pecan
Hazelnut
Buckbrush
American Plum
Redcedar
Persimmon
Rough-leaved Dogwood

Strongly Acid Soils

Bur Oak
Pin Oak
Shumard Oak
Sumacs
Blackberry
Buckbrush
River Birch
Baldcypress
Indigobush
Rough-leaved Dogwood
American Plum

Very Strongly Acid

Pin Oak
Baldcypress
Pines
River Birch
Sumacs
Blackberry

Compacted Soils

Bur Oak
Pin Oak
Swamp White Oak
Baldcypress
Sycamore
Green Ash
Silver Maple
Persimmon
Sumacs
Blackberry
American Plum

Poorly Drained Soils

Pin Oak
Swamp White Oak
Baldcypress
Sycamore
Green Ash
Silver Maple
River Birch
Buttonbush
Indigobush
Willows

Streambank Stabilization Species

Pin Oak
Bur Oak
Sycamore
Cottonwood
Green Ash
Willows
Buttonbush
Indigobush
Ninebark
Gray Dogwood
Silver Maple
Baldcypress
River Birch

A Summary of DOs and DON'Ts for Reclamation with Trees*

DO:

1. Rip or at least chisel-plow compacted sites before planting.
2. Avoid dense ground cover of highly competitive species.
3. Use herbicides as needed.
4. Make sure tree seedlings or seed is properly stored and planted.
5. Plant at the right time.
6. Keep tree roots moist at all times.
7. Use adapted woody species from similar climatic zones.
8. Choose species not palatable to deer if browsing is a problem.
9. Protect trees after planting.

DON'T:

1. Avoid stony soils.
2. Apply high rates of fertilizer.
3. Sow highly competitive types of ground cover.
4. Sow ground cover at high rates.
5. Plant unhealthy or damaged stock.
6. Plant seedlings that are too small or prune large stock excessively.

* Reprinted with permission, Ashby, W. Clark, and Willis G. Vogel. *Tree Planting in the Midwest: A Handbook*. Coal Research Center, Southern Illinois University, Carbondale Illinois, 1992.

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